

ELECTRICITY AS A THERAPEUTIC AGENT— WHAT CAN BE DONE TO DETERMINE ITS VALUE?*

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THERE are few subjects toward which the mind of the medical practitioner is more in need of proper adjustment than that of the use of electricity as a therapeutic agent. It is now more than a century since a professor of anatomy in the University of Bologna announced to the profession—that is daily puzzling its brains over the various ills that flesh is heir to—that he had discovered, in the association of dissimilar metals with the legs of decapitated frogs, a force was generated capable of acting as a substitute for nerve impulse in causing muscular contraction.

Electro-physiological inquiry received a new impulse from this discovery of the effects of a continuous or galvanic current on living tissue, and from that time on there has been an unceasing activity displayed by many of the best minds in the profession in adding to our knowledge of the power of electricity in modifying and controlling the vital processes going on in animal structure, until medical and scientific literature is burdened with the rich fruits of their researches.

Many of the discoveries in electro-physiology suggest valuable additions to our therapeutics, and while there have not been wanting examples of able men in the profession like Remak, Duchenne, Von Ziemmsen, Erb and De Watteville, who have used their best energies to gain for electro-therapeutics the recognition which its importance deserves, its power as a curative agent is as yet but imperfectly understood by the vast majority of physicians. The reason for this is readily explained. The work of the physiologist, though indispensable as antecedent to rational

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therapeutics, is often in too crude a state to be readily made available by the busy practitioner. A hiatus exists between the discoveries of pure science and their practical application to the requirements of every-day life. Men are rare who have either the time, the opportunity or the ability to acquire such experience in both fields of research as to adapt the discoveries of the one to the needs of the other. Electric physics, physiology and pathology each are so comprehensible in their scope that, with the best facilities, a lifetime is spent in acquiring a knowledge of what is known of each. It is no wonder, then, that during the past century, in which so much has been revealed concerning the mysterious working, both on the organic and inorganic world, of that strange force we call electricity, so little practical use has been made of it by the physician, and that it has, in common with many other discoveries in the twilight of their early dawn, been seized upon by the impostor and charlatan as suitable instruments with which to prey upon the minds and pockets of a credulous and expectant world; and when, in addition to this, we recall the fact that there has existed among those who have attempted to direct our minds toward the therapeutical application of electricity the greatest diversity of opinion as to the form of currents that should be used and the methods for applying them, and that no attempt has been made at uniformity even in the instruments employed for this purpose, it is not surprising that electricity as a therapeutic agent has been looked upon as of rather doubtful efficiency by the majority of physicians. But, fortunately, while these causes have operated to bring electricity into some disrepute in the minds of conscientious practitioners of medicine, the rapid strides it has made in other fields of usefulness have raised it in importance and esteem, so that its power and efficiency must be everywhere recognized by the man, be he medical or lay, whose daily life is so dependent on its labor. It now requires but little argument to convince any man that electricity may probably effect some change in the disordered state of his bodily economy who every hour of the day is depending upon this selfsame force to aid him in the mi-

nutest details of his daily life. Nor does the *physician* now entertain the same contempt which once he might have done for an agency which, in these latter days, lights up his house, washes his linen, stitches his clothes, prints his newspapers, cooks his meals, transports him to his office, and brings him into communication with his patients, far or near, while sitting at his desk. So insidiously have the commercial uses of electricity crept in upon us, and so indispensable have they become already to our comfort, that were we, as a people, thrown back on the resources of even a decade ago, we would feel somewhat the same uneasiness and discomfort that Rip Van Winkle expressed on waking from his long sleep. While the profession at large has given but little or no attention to the therapeutic uses of electricity, there has been a skirmish line in advance of the main body that has not been idle, and along this line there have not been wanting bold and self-reliant spirits who, with the directness of aim and the clearness of observation of the sharpshooter, and with a genius for experiment and fertility for invention seldom excelled, have done efficient work in making inroads on diseases that have not yielded to other modes of treatment, or, if so, with far less readiness.

We do not question that claims have been made for electro-therapeutics that are fallacious and unsound, but, granting this, the work of the last fifteen or twenty years leaves much that can withstand severest criticism and will compare favorably with the results obtained by any other method of treatment of disease that receives the unqualified approval of the profession. The work of such men as Erb, De Watteville, Apostoli, Keith, Beard, cannot be turned aside with a sneer, while the universal testimony of the neurologists that this agent is indispensable to the successful treatment of a long range of diseases coming under their management challenges our acceptance and respect.

The therapeutic effects of electricity, as far as they have been determined by physiological and clinical observations, may be classified as *stimulant* or *electro-tonic*, *sedative*, *elec-*

trolytic and *cataphoric*. To these should be added the *cauterizing* action, since the galvano-cautery has a range of therapeutical applications peculiar to itself.

STIMULANT ACTION.

The *stimulant* and *electro-tonic* influence of certain forms of electric application is readily demonstrable, and is applicable to a great variety of conditions of bodily derangement. Where muscular tissue lacks tone, whether it be voluntary or involuntary, striped or unstriped, it can be readily subjected to the stimulating influence of the electric current and in a variety of ways. For this purpose we can employ the static machine, the cathode of a continuous current, or the induced current completely interrupted or alternating, and, by the selection of one or the other of these forms, according as it seems best adapted to the condition, the functional vigor can be aroused in an organ in which such muscular tissue forms an essential part. And how universal are such tissues throughout the body! Thus the circulation in any part may be quickened, passive congestions overcome, congested organs relieved, and the evil results of malnutrition from excess or lack of blood in a part, or from feeble efforts at elimination, may be corrected by this action of the electric current. Functional disorders due to failure in vaso-motor control are especially benefited by such applications.

The good effects of such currents are daily demonstrated in the clinic by increased growth in paralyzed limbs, relief of pain, improved action of the viscera and an increased sense of well-being manifested by the patient's manner and action. A torpid liver, a congested spleen, constipated bowels due to lack of secretion or feeble peristalsis, a congested or subinvolted uterus, chronic congestion of the ovaries, exhausted nerve centers with attendant hyperæmia or anæmia, producing those perplexing states of neurasthenia or spinal irritation, are all conditions that can be helped by electric stimulus. And what have we to look to in our *Materia Medica* that will accomplish like good results with less damage to the organism as a whole? What can

you apply or introduce that will reach the offending spot with as much precision, or do less damage by its presence while it gives the needed help? It certainly adds energy where energy is wanting, and when its work is done, it leaves no *débris* behind to clog the further working of the part.

SEDATIVE ACTION.

As a temporary *sedative* both the induced current and the anode of a mild, continuous current are of service. They calm the neuralgic pains of many functional and organic disorders; they relieve headaches due to congestion or migraine; they allay the pains of muscular rheumatism, of pleurodynia and painful menstruation, and the lightning-like pains so common in locomotor ataxia are often more promptly and permanently controlled by this than by any other means. The manner of action through which this effect is brought about by the electric current is open to speculation. It may be in one of a variety of ways; by subduing a congestion which is the cause of the pain; by stimulating absorption or elimination of some deleterious effete substance; possibly by hastening the decomposition of an irritating product which is formed as the result of imperfect or misplaced metabolism; or the purely physical influence of vibrating movement induced in the nerve structure may account for the soothing effect. Whatever it may be, the calmative influence of these methods of electric application is daily exhibited in a great variety of painful affections, and sufferers of all ages and temperaments bear grateful witness to its efficiency in affording them relief.

ELECTROLYTIC ACTION.

The electrolytic action of the continuous current—that is, the power it has to bring about chemical decomposition and change the atomic arrangement in the composition of compound substance—is credited with very important therapeutic effects.

Electrolysis, by freeing the acid constituents of the tissues at the anode, and the alkaline at the cathode, is a con-

venient means for promoting styptic or caustic action, which can be readily applied and accurately limited, and has of itself a wide range of application in the diseased body. But if, as is claimed, it can be proved by actual experiment or from clinical data that all tissues lying between the rheophores of a continuous current are directly modified in nutrition or vital action by its influence, according to the quantity or intensity of the current, who is there so rash as to attempt, in this the infancy of the rational use of electricity as a therapeutic agent, to mark out the limitation of its powers? No matter where, upon or within the body, disease has begun its havoc, the continuous electric current may be made to traverse the part and work such change as comes within the province of its powers. What these powers are over living tissues the physiologist and clinician must determine, but may it not be, with some reason, anticipated that normal tissue will be found to be stimulated to more vigorous action and resistance by its aid, while abnormal processes are checked and substances foreign to the part, as effete matters or germ colonies, will be found unable to withstand the additional energy of this opposing force. If such change can be proved to be wrought by this mysterious agent in the secret laboratory where cells and blood carry on their incessant interchange in harmony or discord, then no one will deny that, in the continuous current, we have a therapeutic agent which, for many disorders within the realms of both medicine and surgery, surpasses all other means at hand, and testimony in medical literature is accumulating in such abundance and from such high sources, as the result of accurate methods and critical observation, to the effect that herein we have a resource which will *cure*, where hitherto we have only been able to *destroy* the part affected, that it challenges investigation, if not adoption, by every member of the profession.

CATAPHORIC ACTION.

The cataphoric action of the continuous current gives promise of aiding us materially in many ways. The introduction of medicinal agents into the body through the skin

is oftentimes desired, and any method that will accomplish this with greater certainty than those now in use will be a valuable acquisition. The discovery of lanolin as an excipient for remedies applied by inunction was a great advance. But if, by employing the anode of the continuous current, we can hasten this process of absorption and cause medicines to penetrate the cuticle and thus reach directly the offending tissues, it will, in many instances, be of great service. This power to increase or reserve osmosis which the continuous current is said to possess will, if true, have abundant duties assigned to it in the removal of dropsical effusions from cellular tissues, joints and cavities. The contributions of Munk, Von Bruns, Corning, Peterson and others have furnished us with much interesting information on what they claim is the cataphoric action of electricity in carrying remedies and anæsthetics through the skin, and it has even been suggested by a well-known and highly esteemed surgeon in a recent article "that the principle of the process that causes absorption or diminution of the bulk of an uterine fibroid treated in this manner (*i.e.*, by the constant electric current), must be looked for in some form of electrical osmosis."

CAUTERY ACTION.

The advantages offered by the galvanic cautery over any other surgical procedure are chiefly found in the removal of growths of vascular or fungus character, or in arresting the progress of ulcers and malignant diseases in passages of the body narrow and remote from the surface, like the nasal fossa, the eustachian tube, the pharynx, larynx and external auditory meatus, the bladder, urethra and uterus. By this method the cautery snare or knife or scoop may be nicely adjusted to the necessities of the case, and when all is in readiness the heat is generated in the cauterizing tip, with the definiteness of application and range of intensity perfectly under control. In skilled hands its action is perfect, and for such cases all other methods of treatment are but bungling substitutes.

Let us briefly enumerate a few of the results attained by electricity, which have directly advanced the science of medicine and surgery. The physiologist, by the discovery of the laws of electro-tonus, has made it possible for us to determine the condition of a paralyzed muscle, thus greatly advancing the accuracy of diagnosis after injury or disease of brain, or cord, or nerve.

For the increase of our knowledge of *cerebral localization*, with the marvelous results in *cerebral surgery* which have followed so rapidly in its train, we are almost wholly indebted to the electrical experiments upon the brains of animals by a host of investigators. As a remedial agent it is claimed that—

It restores the action and increases the growth of paralyzed parts.

It arouses vital action.

It improves nerve conductivity.

It contracts muscle.

It hastens osmosis and absorption.

It excites secretion.

It quickens the circulation.

It aids elimination.

It allays pain.

It makes hypodermic medication possible without puncturing the skin.

It destroys superfluous hairs, removes warts, moles, sebaceous cysts and epitheliomas.

It checks the ravages of lupus and other ulcers.

It heals bed sores.

It arrests keloid growths.

It dissolves away cicatrices in the skin and along mucus channels forming structures.

Thus, Stricture of the lachrymal duct,

“ “ eustachian tube,

“ “ œsophagus,

“ “ os uteri,

“ “ rectum,

“ “ urethra,

are all amenable to this treatment.

"Not long ago, physicians and surgeons of repute flouted the treatment of urethral strictures by electrolysis. Now it is so generally and successfully practiced that scarcely any oppose it."¹ . . .

"There is no comparison between the treatment of strictures of the urethra by the ordinary methods and its treatment by electrolysis. Should the permanency of the good results prove to be, as a rule, not so great as those recorded, still the calibre of the stricture remains enlarged for a longer space of time than after any other form of treatment."²

Like testimony from reliable sources as to its superiority over all other methods for the relief of strictures and the disorders consequent upon them in the other localities named is not wanting.

It coagulates the blood in aneurisms, nævi, and varicose veins.

Dr. John Duncan, surgeon to the Edinburgh Royal Infirmary, declares: "I have no hesitation in saying that the only justifiable method of treatment for cirroid aneurism is electrolysis."

We all know the claims of Apostoli and his followers for the treatment of uterine fibroid-myomata by electrolysis, and it needs but be said that larger experience and improved methods have but confirmed and rendered more positive his earlier view, *i.e.*, that it is a method for treating the majority of cases superior to all others, and in this he is ably backed by Keith and numerous lesser lights. Keith's latest conclusions are thus stated in his own words:

"This treatment *almost always* relieves pain. It *almost always* brings about diminution of the tumor, sometimes rapidly. It *almost always* stops hemorrhages, sometimes rapidly. The results are *almost always* permanent, and the

¹ Electrolysis in the Treatment of Urethral Strictures. *New Eng. Med. Monthly*, Dec., 1889.

² W. E. Stevenson, M.D. Wood's Monographs. "Use of Electricity in Surgery."

growth of the tumor, if it be not lessened, is stopped. The general health is *immensely improved*. By *almost always*, I mean *nineteen cases out of every twenty*."³

The prostate gland, homologous in structure with the uterus, and subject to like abnormal growth, has proved a perplexing problem when enlarged. Both physician and surgeon have expended upon it their best endeavors with but small reward; but some encouragement may now be held out to the sufferer and his physician, for recently it has been said, by one whose experience and opportunity for observation give weight to his words, "We have no hesitation in defining this as the only truly remedial treatment known for the hypertrophy of this gland in *restoration of its function*, operative procedure looking, as is evident, to its greater or lesser destruction."

Such an array of victories claimed in the name of electricity demands of the profession proof or disproof.

But how are we to go about separating truth from error in these claims, and by what means can we determine with accuracy the limitations and capacities of this powerful force in nature for the treatment of disease? Hitherto we have, for the most part, acted like children in our dealing with the matter, for, with medical batteries as heterogeneous in their variety and construction as the weapons of our revolutionary forefathers in their first contests with the king's regulars, we attempted a crusade against the hidden mysteries of disease with a force, in its essence powerful, it is true, but hampered by our ignorance and the conditions under which we sought to operate it. No wonder that failure in cure followed such crude application, and that rumors of better results were met with incredulity.

We believe that we are about to enter upon a more thoughtful age, and are now, as a profession, prepared to soberly seek out and conform to those conditions which are indispensable for determining the effects of this all-prevailing force on the human body, both in health and disease.

³ *British Medical Journal*, Feb. 14, 1891.

THE FIRST REQUIREMENT.

The first requirement for a rational electro-therapeutist is, that he who undertakes to practice it should be well drilled in electric physics and physiology.

In no branch of practical medicine and surgery can a knowledge of the natural science be safely ignored, but nowhere is such knowledge so indispensable to success as in the practice of electro-therapeutics, and yet how many of our medical colleges demand even an elementary training in physics as a condition for entrance? And how few furnish any instruction worthy of the name in the regular curriculum.

How many physicians who are daily making use of electricity in their practice could explain the construction of the apparatus they are employing, or the conditions it must comply with in order to generate a current? I have known a physician in high standing, a professor in a medical college, to use a galvanic battery of simple construction for a period of three months in making daily applications to a patient, and during that entire time there was no current passing through the conducting cords, he having failed to join the proper connections. And such mortifying instances, discreditable to the profession, could be related *ad nauseam*.

One who makes use of an electric battery should be as familiar with its construction and action as an oculist with his ophthalmoscope, or an engineer with his engine; but how many expensive batteries do we see lumbering up physicians' offices, useless and set aside because of a corroded connection or a broken wire! It is, perhaps, fortunate so many accidents do happen to medical batteries, for electricity is a dangerous tool in the hands of one who knows so little of the conditions upon which its action depends.

Hand in hand with ample knowledge of electro-physics should go a familiarity with the action of electric currents on the normal living tissues. The laws of electro-tonus; the effects peculiar to the anode and the cathode; the variation in resistance of different tissues, all are essential factors in the information requisite to an intelligent use of electricity in therapeutics.

Practical demonstrations and practical experience in electro-physiology as laboratory work under competent instructors, can alone fit the student for practicing intelligently this occult science. As reasonably might the physician, or he who dignifies himself by that title, attempt a cure by dealing out unknown drugs from his medicine case, as to use electricity on his patients without such antecedent preparation.

THE SECOND REQUIREMENT.

The second requirement for securing a rational, scientific position for electricity among therapeutic agencies is a uniformity in the means employed for its application to the body.

We have, at present, no less than fifty manufacturers of electric batteries and appliances for medical use and no two of them have adopted the same pattern or means for generating currents. On the contrary, trade enterprise has stimulated inventive ingenuity to produce diversity rather than uniformity in order that it might be made an additional argument for the sale of that particular variety of instrument. Many physicians in this, as in many other therapeutical measures, take suggestions from non-medical men as to what instrument they require and how their patients should be treated. Those members of the profession who have, from personal experience, discovered the essentials of a medical battery, rather than the instrument maker, should be looked to for information as to what are the best and most suitable forms of batteries for therapeutical purposes. Some standard should be adopted for a constant current battery, an induction coil, volt meter and a milliamperemeter.

It is rare if any two physicians at the present time who daily employ electricity in their practices do it in like manner. They cannot, therefore, compare results, since they are not assured that in the treatment of similar diseases they have subjected their patients to the same conditions. Should I, in Michigan, wish to test upon my patient the effects of electric treatment claimed by a fellow practitioner

in New York or elsewhere to be successful, how can I know that my "McIntosh" is furnishing the same current that he used from his "Kidder," since our milliampèremeters have never been compared, and the voltage and resistance are not reported.

Recently, effects have been reported in a prominent journal by an eminent electric therapist as having been brought about by the use of the induction current. That seems to me incredible, but am I justified in denying his statement until I know what form of instrument he made use of, and have myself used the same in like manner and so determined the inaccuracy of his conclusions?

Nothing differs more than the intensity of the currents generated by induction coils; therefore, without a standard instrument, which is the same wherever used, no progress toward uniform results can be made. Until within a few months, there has seemed to be no way open for securing this much-desired harmony and uniformity in electro-therapeutical appliances, but the organization of an *American Electro-Therapeutical Society*, in January last, gives promise of better things, and may we not hope that, through the labors of this organization, we will soon receive definite instructions as to the best instruments to make use of, and the best methods for applying them.

In this connection, let me suggest that the tendency should be toward the simplest and least expensive instruments consistent with efficiency. Many of the obstacles to the progress of electro-therapeutics have arisen from the high price, complexity and frailty of the instruments furnishing the current.

One drawback, and that perhaps the most fruitful in retarding good work, lies in the use of fluid batteries for generating both constant current and the primary circuit for induction currents. Many of the annoyances arising from this source, such as the deterioration of the fluids, the consumption of the elements when the battery is not in use, the corrosion of the connections in the circuit, can now be overcome by using a dry cell. I have for months made use of a dry cell for running induction coils, and found it

very satisfactory. You who have occasion to use portable batteries can readily appreciate the advantages to be derived from substituting a dry for a wet cell in all portable machines. Even for stationary work the dry cell is superior on account of its cleanliness, but in matter of durability it requires some improvement.

Nothing, in my opinion, will eventually be found so convenient for office work as the use of commercial currents.

The Edison incandescent current, with its constant voltage of near 110, affords an admirable source of electric power for electrolysis, cataphoresis, inductive stimulation, and cautery purposes. By a very simple appliance for changing the voltage, I have used this current in my office for more than two years, and the same method applies quite as well to the currents of equal or less voltage from other sources, whether they be alternating, as the Thomson-Huston dynamo, the storage battery, or any form of primary battery plant that has sufficient electro-motive force.

To sum up, therefore, the ideal conditions for establishing electro-therapeutics on a scientific basis, they are :

1st. A thorough preparation in electro-physics, physiology and therapeutics on the part of the operator.

2d. A *source of electric power*, as a dynamo or storage battery with a constant, unvarying voltage, from which the current is conveyed to hospitals, physicians' offices or patients' houses.

3d. A *current regulator*, rheostat or modifier by which the strength of the current may be adapted to the required needs of individual cases, and this should be of convenient size, durable in construction and simple in arrangement. The simplicity, economy and efficiency of such appliance would insure its being readily adopted by the profession.

4th. A *series of electrodes*, which should be constructed according to a fixed standard as to size and shape, and they should be made of material which is cheap, readily conducting and non-polarizable.

5th. All should make use of a *standard milliamperemeter* for determining "strength of current," and a *colombmeter* for "quantity" or dose.

Complying with such conditions as these, progress in determining the limitations of electricity as a therapeutic agent would advance with rapid strides. The incandescent electric light plants, with low electro-motive force, are very common throughout the country. The physician and dentist finds the current extremely useful in his office. It illuminates his apartments, it runs his motors, it lights the tiny lamps with which he explores the cavities of the body, it heats the water for his sprays and douches. It will not be long before it will be made use of by the many, as it has been by the few for some time, for all the applications of electricity to the human body, since it does away with a host of difficulties that have, up to the present, been of such magnitude as to make electric applications either a burden or a farce.

HYOSCIN POISONING.

As this drug is used so frequently in the treatment of psychoses, any information in regard to its action is always received with favor. Dr. Adler, in the "Centralblatt f. Nervenhe.," reports a case of accidental poisoning with muriate of hyoscin. The exact quantity of the drug taken was not known, but the amount was supposed to be more than fatal, as it stood in a glass as a sediment in which a drink of water was taken by mistake. Fifteen minutes after it was swallowed dizziness came on, with gradual loss of consciousness. In an hour convulsions became general, followed by coma. The face was livid, pupils dilated and fixed, pulse 145, very small and soft. The stomach pump was used, but no hyoscin could be detected in the fluid. Hypodermics of morphia were given, but the spasms continued. Five hours later an injection of pilocarpine was given with no reaction resulting for three hours, when moisture began to appear on the lips and tongue. From this on the recovery was gradual. In eight hours after the ingestion of the drug the patient was able to speak, the pulse to fall, and convulsions to cease. By the following morning all that remained of the trouble was a slight weakness and some accommodation paresis. B. M.